Biochemistry (Renal module)

❑ Biochemistry of renal function

Shuzan Ali Mohammed

Medical Biochemistry & Molecular Biology

Faculty of Medicine- Benha University

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Biochemistry of renal function

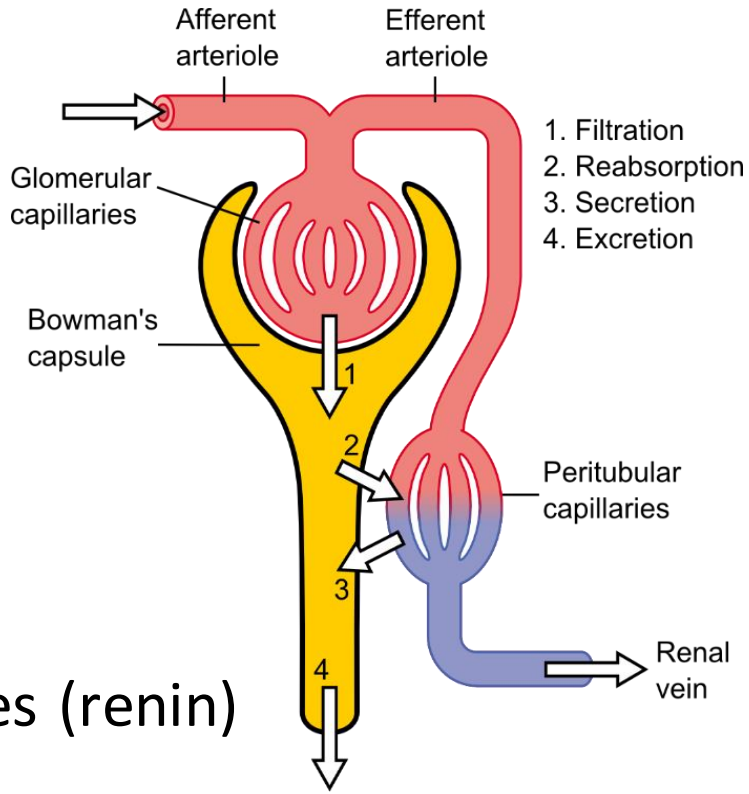
Definition:

Kidney function tests is a collective term for a variety of individual tests and procedures that can be done to evaluate how well the kidney are functioning.

Functions of the kidney:

1. Maintenance of homeostasis
2. Excretion of metabolic end products
3. Elimination of foreign materials
4. Regulation of acid base balance
5. Retention of vital substances
6. Regulation of arterial pressure
7. Production of hormones

(as erythropoietin, calcitriol) & enzymes (renin)



Excretion = Filtration – Reabsorption + Secretion

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Tests for kidney functions:

I. Blood tests:

1. Serum creatinine:

- Creatinine is a waste product comes from normal wear and tear of muscles
- Creatinine varies with age, race and body size
- The normal plasma creatinine level:

  0.5 – 1.1 mg/dl in adult females

  0.6 - 1.2 mg/dl in adult male
- If it is > 1.2 for ♀ and > 1.4 in ♂, it is an early sign that the kidneys are not working properly.
- As the kidney disease progresses, serum creatinine rises.

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Tests for kidney functions:

I. Blood tests:

2. Blood urea nitrogen (BUN):

- Urea nitrogen comes from the breakdown of protein in the food you eat.
- Normal BUN is 7 – 20 mg/dl
- As the kidney function decreases, the BUN level rises.

3. BUN / creatinine ratio:

- The ratio can indicates kidney disease or other conditions as dehydration and intestinal bleeding.

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Tests for kidney functions:

I. Blood tests:

4. Uric acid:

- Uric acid is the end product of nucleoprotein metabolism
- Its increased level is called hyperuricemia
- Its decreased level is called hypouricemia
- Uric acid normal level:
  3 – 7 mg/dl for males, 2 – 6 mg/dl for females

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Tests for kidney functions:

I. Blood tests:

5. Cystatin C:

- A protease inhibitor, nonglycosylated low molecular weight protein, produced by **all nucleated** cells at a constant rate and is freely filtered by the kidney and completely metabolized by the proximal tubules
- Its serum concentration is an endogenous marker of glomerular filtration rate (GFR)
- Cystatin C is an effective marker for GFR in patient with cirrhosis following **liver transplantation** **(hepatorenal syndrome)**.
- Cystatin C is more useful for detecting early renal impairment in both type 1 & 2 **DM**
- Cystatin C was associated with mild kidney dysfunction with increased risk for **cardiovascular** events, peripheral arterial disease and heart failure.

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Tests for kidney functions:

I. Blood tests:

6. Calcium:

- Normal calcium level are important for healthy bones, nerves, kidneys, teeth.

7. Sodium, potassium, chloride, carbon dioxide:

Improper electrolyte balance indicates; dehydration, Addison disease, kidney disease and diabetes.

8. Albumin: a protein important for healthy liver and kidney function

9. Phosphorus / phosphate:

Low phosphorus level can be indicative of a number of diseases while high level may denotes kidney failure

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Tests for kidney functions:

I. Blood tests:

10. Glomerular filtration rate:

- The test measures how well the kidneys are removing wastes and excess fluid from blood
- It is calculated from serum creatinine level using age & gender with adjustment of those of African American descent.
- Normal GFR varies with age (as you get older it decreases).
- The normal GFR is 90 or above
- Once the GFR decreases below 15, one is at high risk for needing treatment for renal failure, such as dialysis or a kidney transplant.

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Tests for kidney functions:

I. Urine tests:

- Some urine tests require only a couple tablespoons of urine, others require collection of all urine produced in 24 hours.
- A 24-hour urine test determine the amount of urine produced in a day, provide accurate measurements of how well the kidney functions and the amount of protein leak from the kidneys in urine

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Tests for kidney functions:

I. Urine tests:

1. Urine analysis: microscopic examination & **dipstick** test

- The dipstick test is a chemically treated test strip which is dipped in urine.
- The strip changes color in presence of abnormalities as excess protein, blood, pus, bacteria and sugar.
- A urine analysis can help detect a variety of kidney and urinary tract disorders as chronic kidney disease, diabetes, bladder infections and kidney stones.

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Tests for kidney functions:

I. Urine tests:

2. Urine protein: may be part of urine analysis or done by a separate dipstick test.

- An excess protein in urine is called proteinuria
- A positive dipstick (1+ or more) should be confirmed by a more specific dipstick test as an albumin specific dipstick or a quantitative measurement as albumin / creatinine ratio.

3. Microalbuminuria:

- A more sensitive dipstick detects a tiny albumin amount
- Patients with increase risk of developing kidney disease as those with DM or hypertension should have this test or albumin / creatinine ratio if the standard dipstick test for proteinuria is negative.

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Tests for kidney functions:

I. Urine tests:

4. Creatinine clearance:

- Creatinine clearance test compares the creatinine level in a 24- hour urine to the creatinine level in blood to show how much waste products the kidney are filtering **each minute.**

5. Albumin / creatinine ratio:

- A microalbumin creatinine ratio is most often use to screen people at increased risk of kidney disease (DM & hypertension).
- Identifying kidney disease at an early stage can help prevent serious complications